Common Task B: Liquid Wall-Bulk Plasma Interactions

Task Leader: Robert Kaita

FY 2002 Tasks:

Note: The budget numbers are only for PPPL ($141K). Common Task B formerly included University of Texas activities, which now appear under Task V.

PURPOSE

The work is a continuation of Advanced Power Extraction (APEX) activities that proceeded during FY01 in this task area. The primary participating institutions are the Princeton Plasma Physics Laboratory (PPPL), the Institute for Fusion Studies at the University of Texas (IFS), the University of California at Los Angeles (UCLA), and the Sandia National Laboratories (SNL). They are divided among three APEX task areas as follows.

Task I. Explore options and issues for implementing a flowing liquid wall in the National Spherical Torus Experiment (NSTX) - $55K

1. Characterization of NSTX operating conditions – provide for high power auxiliary heating as required by UCLA, SNL, and other members of the APEX effort for their design of liquid walls for NSTX. Provide information needed to design liquid lithium test module from both NSTX and CDX-U. **$25K (Kaita)**
2. LM experimental facility set up and initial exploratory experiments with and without magnetic field gradients and applied currents: Participate in the experimental planning and provide engineering support for facility operation and upgrades.

   This is an ongoing "level of effort" support request from UCLA for Woolley. (PPPL and UCLA) **$15K (Woolley)**
3. Identification of key issues and development of an R&D plan for implementing liquid walls in NSTX: Participate in design of liquid lithium test module for NSTX. **$15K (Kaita)**

Task II. Exploration of High-Payoff Liquid Wall Concepts - $30K

1. Engineering properties of the liquid lithium itself: Progress on the comparison between methods of propulsion (e. g., electro-magnetic propulsion vs pumping) will be reported, including results of tests in dedicated experimental devices. This supports part of Zakharov's time so he can continue to develop new concepts and applications for liquid walls. (PPPL) **$30K (Zakharov)**

Task V. Exploring Moving Liquid Metals for Plasma Stabilization - $56K

1. Stabilizing effects of flowing lithium on MHD modes – continue to evaluate the conditions under which flowing lithium will have an effect on the resistive wall mode. (PPPL and IFS) **$26K (Zakharov)**

2. Transport and profile effects of low-recycling properties of lithium : Provide information from simulations of CDX-U liquid lithium experiments and other computational efforts to help develop a model for a spherical torus plasma in contact with a very low recycling surface, including recommendations for further experimental tests.

The Tokamak Simulation Code (TSC) has been "benchmarked" against tokamak plasma data, and it is being used for reactor studies such as ARIES. The goal is to modify the code to simulate liquid walls. If this is successful, the resulting equilibria can examine for stability using programs like the WALLCODE resistive MHD code. This is under development at the Institute for Fusion Studies at the University of Texas. Initially, TSC will be set up with the CDX-U lithium tray as a solid conductor, and the forces at that location due to induced currents will be estimated. (PPPL) **$30K (Kaita, Woolley)**